

Creeping Bentgrass Golf Ballmark Recovery as Affected by Various Tools on Two Sand-based Research Putting Green Areas with Varying Surface Firmness and Moisture Contents, 2007
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Objectives:

To evaluate golf ballmark recovery of two creeping bentgrass areas with contrasting surface firmness and rootzone moisture contents as affected by various ballmark repair tools.

Rationale:

Unrepaired ball marks can cause extended periods of damage that can affect the aesthetic beauty and playability of golf course putting greens. An abundant amount of hours and money is spent repairing ball marks made to golf greens. Standard long-tong tools and tees, when improperly used, may actually cause more damage than not repairing the mark at all. New technologies such as short-tong tools and the “just push” technique may have benefits such as less turf damage and less chance of “misuse” by golfers. Determining what tool and technique to use can greatly reduce ball mark recovery time. Along with determining what technique or tool is best suited to repair ball marks the moisture and firmness of a putting green can also affect ball mark size and recovery time.

How it was done:

This study was conducted on a nine year-old, actively growing stand of Pennlinks creeping bentgrass cultivated on a sand-based research putting green located at the W.H. Daniel Turfgrass Research and Diagnostic Center (West Lafayette, IN). The green was maintained with tri-plex mowed six times per week at 0.140 inches, irrigated via an overhead irrigation system to supplement rainfall every 1-2 days, providing approximately one inch of water per week and fertilized with approximately 3 lbs. N 1000 ft² yr⁻¹. No sand topdressing or core cultivation occurred during the study period.

Prior to initiating the experiment the study area was divided into two distinct areas (approx. 15 x 20 ft) to create a “firm” and “soft” location. The firm area was conditioned by repeatedly rolling the area with a GreensIron 3000 sidewinder roller (Figure 1) until an average surface hardness value of 145 g_{max} was achieved as measured by the Clegg Impact Soil Tester using the 0.5 kg hammer. The soft area was heavily hand-watered until ponding occurred. The average surface moisture contents at the 0-2 inch depth were 20 and 28 % for the firm and soft areas respectively. The surface hardness value for the soft area was 100 g_{max}.

Ballmarks were naturally created on 12 June, 2007 by the impact of golf balls struck into the research area from a distance of approximately 100 yards using a pitching wedge (Figure 2). Four ball mark repair tools (Traditional long-tong tool, Angled long-tong tool, GreenFix Wizard, standard length Wooden golf tee) plus an unrepaired ballmark were randomly assigned to the marks within each location and repaired approximately fifteen minutes after they were created. Ballmarks were repaired according to manufacturer’s directions.

Data were collected for ballmark quality or appearance and scar area at 0, 3, 5, 7, 14, 21 and 28 days after initial golf ball impact. Quality was rated using a 0-10 scale where 0 equaled severe injury, no evidence of scar healing, and 10 equaled full turf closure, a completely healed and recovered mark with a smooth surface when viewed from eye level. The average scar area was calculated by measuring each mark with a translucent ruler in two perpendicular directions to the nearest millimeter and calculating an average radius which was used to determine the average scar area (Figure 3). Relative ballmark cavity volume was determined for three representative marks in each location by placing a thin sheet of plastic food wrap over the mark and carefully dropping fine sand into the wrap to fill the cavity until the sand was level with the green surface.

Results to date:

- The sand masses taken from the ball mark cavities were 9.08 and 5.01 grams for the soft and firm surfaces, respectively, and were significantly different demonstrating that soft surfaces create a much larger ball mark than when a golf ball is hit into a firm playing surface.
- Ratings ranged from 0.8 to 9.9 and values generally increased with time as recovery progressed (Tables 1 and 2).
- When averaged across all dates for the soft area the GreenFix Wizard and the traditional long-tong tool had the highest rating values of 7.8 and 7.3 respectively (Table 1). The wooden golf tee or unrepaired marks performed the worst with ratings of 5.4 and 5.0 respectively.
- Ballmark scar areas were largest and most pronounced on the day the study was initiated with scar areas ranging from 205 to 640 mm² (Tables 1 and 2; Figures 4 and 5). The scars in the unrepaired marks in the soft area were substantially larger 640 vs. 459 mm² than those in the firm area.
- For both areas the lowest numerical scar area was measured for the GreenFix Wizard, which was not statistically different from the long-tong tool using traditional method. By comparison the scar areas for the unrepaired marks were 123 and 62 mm² in the soft and firm areas respectively.
- One of the worst performing tools in this study was the traditional wooden golf tee which was similar to an unrepaired mark on all measurement dates in the firm area and six of seven dates in the soft area.

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Figure 1. Overview of preparation procedures, repeated rolling and surface hardness measurements used to create the “firm” study area, 12 June, 2007.



Figure 2. Overview of the study area after golf balls were naturally struck from a distance of approximately 100 yards using a pitching wedge and immediately prior to ballmarks being repaired.



Figure 3. Overview of the method used to determine ballmark diameter and ultimately ballmark scar area. The numbered red tee indicates the treatment and replication number.

Table 1. Creeping bentgrass ballmark quality as affected by various repair tools on two areas with varying surface firmness and moisture content. Purdue University, 2007.

Study Area†	Repair tool	Days after initial golf ball impact‡							Study Mean
		0	3	5	7	14	21	28	
		----- (ball mark quality 0-10) § -----							
Soft surface	GreenFix Wizard	5.3 a*	5.5 a	6.9 a	8.8 a	8.9 a	9.5 a	9.9 a	7.8 a
	Long-tong tool using traditional method	3.8 b	4.9 ab	5.4 b	8.9 a	9.0 a	9.6 a	9.6 a	7.3 a
	Angled long-tong tool	2.5 c	4.3 ab	4.3 b	7.1 b	8.0 b	9.1 ab	9.7 a	6.4 b
	Standard wooden golf tee	1.6 c	3.6 bc	2.9 c	5.9 c	7.0 c	8.4 bc	8.8 b	5.4 c
	Unrepaired	1.3 c	2.9 c	2.9 c	5.1 c	6.3 c	8.0 c	8.6 b	5.0 c
Firm surface	GreenFix Wizard	4.1 a	5.8 a	7.3 a	8.8 a	9.0 a	9.6 a	9.9 a	7.8 a
	Long-tong tool using traditional method	3.1 ab	5.5 a	5.9 b	8.0 ab	8.6 ab	9.0 ab	9.8 a	7.1 ab
	Angled long-tong tool	2.8 b	4.3 b	4.6 bc	7.8 ab	8.5 ab	9.1 ab	9.9 a	6.7 b
	Standard wooden golf tee	2.2 b	3.4 c	4.0 c	6.9 bc	7.8 bc	8.4 b	9.3 b	6.0 c
	Unrepaired	0.8 c	3.4 c	3.8 c	6.5 c	7.4 c	8.4 b	9.3 b	5.6 c

† Initial surface soil water contents were 28 and 20 % for the soft and firm areas respectively and surface firmness values were 100 and 145 g_{max} for the soft and firm areas respectively, using the 0.5 kg hammer on the Clegg Impact Soil tester.

‡ Ball marks were naturally created on June 16, 2007 by hitting balls with a pitching wedge from approximately 100 yards from the study area and all marks were repaired approximately fifteen minutes after injury.

§ Ball mark quality was rated on a 0 to 10 scale where 10 equals full turf closure, complete recovery with a smooth surface when viewed from eye level.

*Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD (P=0.05) and are the mean of eight replicates.

Table 2. Creeping bentgrass ballmark scar area as affected by various repair tools on two areas with varying surface firmness and moisture content. Purdue University, 2007.

Study Area†	Repair tool	Days after initial golf ball impact ‡						
		0	3	5	7	14	21	28
		----- (scar area mm ²) -----						
Soft surface	GreenFix Wizard	205 a*	156 a	127 a	52 a	52 a	11 a	0 a
	Long-tong tool using traditional method	347 ab	238 ab	195 ab	73 a	61 a	8 a	2 a
	Angled long-tong tool	456 b	392 bc	321 bc	196 b	199 b	36 ab	5 a
	Standard wooden golf tee	487 b	438 c	413 c	321 bc	258 bc	89 bc	59 a
	Unrepaired	640 c	509 c	416 c	289 c	285 c	123 c	65 a
Firm surface	GreenFix Wizard	276 a	210 a	119 a	20 a	69 a	15 a	0 a
	Long-tong tool using traditional method	458 ab	224 a	193 ab	54 ab	81 a	31 ab	3 a
	Angled long-tong tool	456 bc	350 b	235 bc	108 bc	113 bc	26 ab	0 a
	Standard wooden golf tee	486 c	356 b	278 bc	135 c	122 bc	71 c	24 b
	Unrepaired	459 bc	350 b	284 c	124 c	165 c	62 bc	14 ab

† Initial surface soil water contents were 28 and 20 % for the soft and firm areas respectively and surface firmness values were 100 and 145 g_{max} for the soft and firm areas, respectively, as measured by the Clegg Impact Soil tester using the 0.5 kg hammer.

‡ Ball marks were naturally created on June 16, 2007 by hitting balls with a pitching wedge from approximately 100 yards from the study area and all marks were repaired approximately fifteen minutes after injury.

§ Ball mark scar area was calculated by measuring the diameter of each scar in two directions to the nearest millimeter then calculating an average scar radius which was used to calculate the scar area as a circle. For comparison the diameter of a standard golf ball is 1.68 in or 42.7 mm which translates into an area of 1432 mm².

*Means in the same column followed by the same letter are not significantly different according to Fisher's protected LSD (P=0.05) and are the means of eight replicates.